FACTSHEET

AGRICULTURAL ENGINEERING

ORDER NO.06-035

APRIL 2006

AGDEX 720/538

Ontario Ministry of Agriculture, Food and Rural Affairs

NUTRIENT MANAGEMENT ACT, 2002

CONSTRUCTING HYDRAULICALLY SECURE LIQUID NUTRIENT STORAGE FACILITIES

[Replaces OMAFRA Factsheet *Constructing Hydraulically Secure Liquid Nutrient Storage Facilities,* Order No. 04-067]

J. Johnson

Ontario Regulation 267/03, as amended, of the Nutrient Management Act 2002 (NMA) provides new requirements for constructing liquid manure storage structures. Part I deals with definitions and interpretation; Part II covers strategies and plans, and is useful for defining terms and determining if and when the Regulation applies to your farm. Part VIII: Siting and Construction Standards, contains the main part of the Regulation applying to liquid manure storage structures.

Requirements for construction of liquid manure storage structures have been included in the act in order to:

- reduce the potential for surface and subsurface groundwater contamination
- provide two levels of environmental protection
- standardize design methods
- standardize construction methods and materials
- clarify construction standards for contractors and farmers

Liquid nutrient storage structures built under the regulation must meet minimum separation distances from wells and drainage systems. A professional engineer or professional geoscientist must take on-site soil samples for lab analysis. As well, the location of the permanent groundwater table or bedrock must be established if they lie within 1.5 m of the base of a concrete or steel structure and within 2.5 m of the base of an earthen structure. The storage structure and any associated nutrient transfer systems must be designed by a professional engineer. The engineer must verify through site inspections that the structure is constructed according to the original design. *Figure 1* shows an in-ground, circular manure storage structure commonly found on Ontario farms.

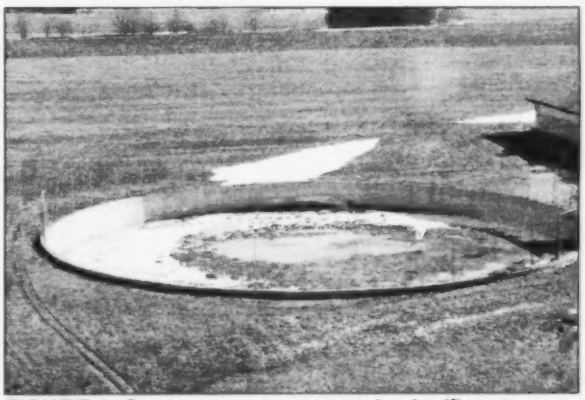

FIGURE 1. Storage structures contain significant quantities of manure. They must be constructed to standards that will minimize leakage.

Technical support for the regulation is included in Nutrient Storage factsheets. The regulation, together with the factsheets, set out the standards for the construction and siting of nutrient storage facilities.

This Factsheet does not present the entire requirements for constructing liquid manure storage structures under the regulation. It provides an outline of the general process required for a person planning to build a new structure or to expand an existing one under the regulation. The owner, contractor, municipal building authority, or professional engineer should contact an Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) nutrient management specialist for complete

requirements of the regulation when siting and building manure storage structures.

ENGINEERING AND INSPECTION REQUIREMENTS

The regulation details the requirements of the engineer and geoscientist. The regulation includes definitions for both "professional engineer" and "professional geoscientist".

Engineering Design

The engineer may need to submit the following information to the municipal building authority:

- a site plan
- a geotechnical investigation, outlining site characteristics
- detailed construction drawings of the storage structure
- detailed construction drawings of a synthetic or compacted soil liner
- detailed construction drawings of all liquid nutrient transfer systems

Additional information the engineer should, provide, where applicable, includes:

- storage sizing including freeboard
- provisions for loading/unloading and agitating
- recommendations for regular maintenance
- details for the ventilation system
- details for safety fences
- signage that identifies risk of manure gas

Engineering Inspection

The owner must hire a professional engineer to provide a general review of construction, which includes:

- making periodic visits to determine if the work is following the design plans
- reviewing the reports of independent inspection and testing companies
- interpreting plans and specifications when requested
- reviewing shop drawings submitted by the contractor

The municipal building authority may require a final inspection report before issuing an occupancy permit.

The Nutrient Management Protocol includes a form that outlines the involvement of engineers retained for the project. It identifies:

- the professional engineer who is responsible for the overall coordination of the design
- the professional engineer(s) who will undertake a general review of the construction

Contact your local OMAFRA nutrient management specialist for a list of professional engineers or professional geoscientists.

SITING

The regulation, details siting restrictions for new or expanded permanent nutrient storage facilities. Siting the structure is the responsibility of the owner. The municipal building official may ask the engineer to submit a site plan. An Ontario land surveyor may verify legal siting details. Some of the general siting requirements for these facilities are included below. These facilities cannot be located within the following minimum distances *(Note that distances in the regulation are in metres. The approximate distance in feet is shown in brackets.)*

TABLE 1. Distances separation between storage structures and wells

Well Type	Well Depth metres (ft)	Minimum Separation Distance metres (ft)
Drilled well	15 m (50 ft.) or greater depth with 6 m (20 ft.) or greater depth of watertight casing.	15 m (50 ft.)
Municipal well	Any depth	100 m (330 ft.)
Any other well Agricultural Source Material Storage Only	Any depth	30 m (100 ft.)
Any other well Non Agricultural Material Storage	Any depth	90 m (300 ft.)

A ≥15 m (≥50 ft.) perimeter distance is needed from a permanent nutrient storage facility to any field drains or piped municipal drains. Exceptions are allowed where the subsurface piping is sealed or the water collected is being treated or the piping has an observation or monitoring well with a shut-off station.

Check with the municipal building authority to determine if a site map is required.

SITE CHARACTERIZATION

If the storage design does not provide two levels of environmental protection on its own, the owner must hire a professional engineer or geoscientist for the site characterization. This process is to identify the soil types and location of bedrock or the long-term ground water table as outlined by the regulation. The geoscientist will obtain a lab analysis of soil samples to determine additional soil characteristics. One test hole is required for every 1,000 m^2 (10,800 ft^2) of ground floor area of the facility. Since test holes can act as a conduit for groundwater, they must be located between 3–10 m (10–33 ft.) away from the perimeter of the facility.

The soil types must be identified to a depth of at least 1.5 m (5 ft.) below the bottom of the storage facility. If the storage facility is constructed of earth, soil types must be identified to a depth of at least 2.5 m (8 ft.) below the bottom of the facility. The type of soils present will determine the natural permeability or hydraulic conductivity. After investigation, the test holes must be filled and sealed to provide the same or lower level of hydraulic conductivity as the surrounding undisturbed soil.

Once the soil tests are completed and the soil characteristics are known, the geoscientist forwards this information to the engineer coordinating the project design. The geoscientist also forwards recommendations for depth of storage and backfilling procedures. Engineers use the soil characteristics to determine the site and structural requirements for the liquid storage facility.

The regulation defines hydraulically secure soil as a natural soil that is consistent in nature and able to meet a maximum saturated hydraulic conductivity of $1x10^{-8}$ m/sec. The hydraulic conductivity of soil is commonly in the following ranges:

- sand: 10^{-6} to 10^{-2} m/s
- silt: 10^{-9} to 10^{-5} m/s
- clay: 10^{-12} to 10^{-9} m/s

Soils usually contain a mixture of particle sizes, types and material origin. Geotechnical evaluation is important to establish the security of a specific site.

TRANSFER SYSTEMS

Commonly a manure storage system includes a transfer system to move manure from the barn to the final storage facility. Transfer systems rely on gravity or mechanical devices to move the material. Regardless of the conduit used it is important to make secure connections. Rubber gaskets and bell and spigot connections are commonly used to make sure that the transfer piping is watertight. Proper connectors are needed to assure the integrity of the system. *Figure 2* shows a PVC transfer piping system being assembled during barn construction.

In-barn storage structures under slatted floors typically do not require transfer systems.

FIGURE 2. PVC pipe sections await connection and will eventually form a secure liquid manure transfer system from the in-barn tank to the external manure storage structure.

TWO LEVELS OF PROTECTION

All liquid nutrient storage structures must provide a minimum of two levels of environmental protection to control seepage to ground or surface water. In most cases two levels of protection are provided by:

- the structure itself, when using concrete or steel
- an engineered clay liner, synthetic or geo-synthetic liner in the case of an earthen storage
- hydraulically secure soils, having a maximum hydraulic conductivity of 1×10^{-8} m/sec., which act as a barrier for groundwater protection and may be available on the site

Alternative levels of protection may be provided by geo-synthetic clay or geo-membrane liners, increased factors of safety in the structural design, importing clay materials from off-site areas, or alternative designs as specified by the engineer.

SECONDARY CONTAINMENT

Liquid nutrient storage structures that extend above the surface of the ground must be constructed so that at least one of three conditions are met:

- A factor of safety is applied to the design as determined by an engineer to increase structural integrity.
- An engineer specifies a secondary containment system is not required.
- The above grade portion of the storage has a secondary containment system with a capacity that

will store 110% of the above ground portion of the facility.

STRUCTURAL DESIGN

For liquid storage structures, the owner must hire a professional engineer for the structural design of the storage facility. The intent of the design is to minimize leakage, minimize corrosion and to create a strong and durable structure.

The design must include provisions for two levels of protection and consider loads from liquid nutrients, soil and backfill, snow, ice, wind, temperature stresses, creep and shrinkage, machinery and other criteria the engineer determines.

There are several types of liquid storage structures. The structure chosen depends on characteristics such as the storage size, site requirements, distance separations and cost. Storage structures include: round or rectangular tanks typically made of reinforced concrete or steel (either in-ground or aboveground), and earthen storage facilities. Discuss the various storage options with the engineer.

Design requirements for concrete and steel storage structures and construction materials are included in regulation and factsheets. Earthen storage design requirements are included in the regulation.

The design must also include details for the permanent transfer system within or associated with the storage facility.

FIGURE 3. This earthen storage structure requires a synthetic liner due to limitations of the site. The clay content of the surrounding soil was not high enough to provide a sufficient level of environmenal protection.

LINERS — NATURAL AND SYNTHETIC

Depending on the levels of containment needed or provided by the site, the engineer will determine if the nutrient strorage facility needs a liner(s). *Figure 3* shows an earthen storage lined with a synthetic liner. A natural liner involves using either native or introduced clay soils to provide the specified hydraulic conductivity. Synthetic liners are materials with very low permeability or hydraulic conductivity. There are several types of synthetic liners available including:

- *geosynthetic clay liners*: liners consisting of high swelling sodium bentonite sandwiched between two layers of geotextile fabric, having a very low saturated hydraulic conductivity
- *geomembrane liners*: synthetic membranes with very low permeability

The engineer will discuss liner options and help determine the type of synthetic liner to use. Preparation of the subgrade surface, installation procedures and placing a protective cover are all critical components of liner installation. These will be specified by the engineer and will include on-site inspection. Installation of accessory structures such as erosion pads, agitator pads, access ramps, and transfer piping will be also be specified and inspected by the engineer.

WHAT SHOULD I DO IF I WANT TO BUILD A NEW LIQUID STORAGE STRUCTURE?

- Contact your municipal building authority and OMAFRA nutrient management specialist to find out about local requirements and if the NMA applies.
- Work with the local building official and OMAFRA nutrient management specialist to determine Minimum Distance Separation requirements for the proposed structure.
- Do a preliminary site investigation to determine locations of wells, field tiles, watercourses, etc. near the proposed structure and provide a site map for local building officials if required.
- If the regulation applies or a municipal by-law requires it, a professional geoscientist is required to determine soil characteristics and locate bedrock or long term ground water table. Test holes and soil lab analysis will be done.
- If the regulation applies or local building officials request, a professional engineer is required to provide the structural design of the storage structure and transfer systems.

- Apply for a building permit.
- A professional engineer must inspect the project during construction.

SUMMARY

An important function of the Nutrient Management Act and the regulation is to mandate the security of structural systems that store liquid nutrients, including liquid manure. A properly engineered project and one that is reviewed by the professional engineer during construction will result in a structure that serves its practical function *and* protects surface and ground water from contamination.

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FOR YOUR NOTES

FOR YOUR NOTES

Do you know about Ontario's new Nutrient Management Act?

The provincial Nutrient Management Act (NMA) and the Regulation 267/03, as amended, regulates the storage, handling and application of nutrients that could be applied to agricultural crop land. The objective is to protect Ontario's surface and groundwater resources.

Please consult the regulation and protocols for the specific legal details. This Factsheet is not meant to provide legal advice. Consult your lawyer if you have questions about your legal obligations.

For more information on the *NMA* call the Nutrient Management Information Line at 1-866-242-4460, e-mail *nman@omafra.gov.on.ca* or visit www.omafra.gov.on.ca.

Factsheets are continually being updated so please ensure that you have the most recent version.

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POD
ISSN 1198-712X
Également disponible en français
(commande n° 06-036)

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